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Item Management at Sulzer Pumps

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Sulzer on teollisuuden tekniikkaan ja tuotantoon erikoistunut yritys. Sulzer on jakautunut neljään divisioonaan, joista tämä insinöörityö on tehty Sulzer Pumpsille. Se on erikoistunut teollisuuden pumppuihin ja sekoittimiin.

Sulzer Pumps on kasvanut huomattavasti yritysostojen kautta. Tämän lisäksi yhtiön eri tuotealueet ovat yhdistyneet toisiinsa. Tämän seurauksena on käynyt ilmi, että nykyään käytössä on useampia eri nimikkeiden tunnistelogiikoita.

Insinöörityössä tutkitaan Sulzer Pumpsilla vallitsevan tuotetiedohallinnan nykytilaa. Erityisesti työssä tarkastellaan kolmea samanaikaisesti käytössä olevaa nimiketunnistelogiikkaa Sulzerin eri toimipisteissä. Tavoitteena on löytää niistä kaikkein käytännöllisin.

Työssä käsitellään aluksi nimikkeiden hallinnan teoriaa, jonka jälkeen esitellään kolme erilaista nimikkeiden tunnistelogiikkaa, jotka ovat älykäs, osittain älykäs sekä täysin tunnoton. Tämän jälkeen käydään läpi niiden hyvät sekä huonot puolet. Sitten vertaillaan kolmea Sulzer Pumpsilla käytettävää nimike tunnistelogiikkaa.

Työn tulokseksi saatiin, että paras nimikekoodilogiikka olisi täysin tunnoton logiikka pohjustettuna hyvällä metadatalla. Aiheen laajuuden takia insinöörityön pohjalta yritys pystyy etenemään PDM-projektissaan rationaalisinta polkua pitkin.

Avainsanat	Tuotetiedonhallinta, nimike, tunniste

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Sulzer is a company specialized in industrial engineering and manufacturing. It is divided into four divisions. From these divisions the Bachelor's thesis was made for Sulzer Pumps which is specialized in industrial pumps and mixers.

Sulzer Pumps has grown through takeovers. In addition, some product groups have been merged. Due to those changes, it has been noticed at Sulzer that they are using several different item numbering systems at different business units.

This Bachelor's thesis studies the current item management at Sulzer. It concentrates mainly on three simultaneously used item numbering systems in order to find the most useful one.

At the beginning of the study, the theory behind the item management is introduced. Secondly it compares three different ways of numbering items. Next, three item numbering systems currently used by Sulzer are presented. Finally, the best numbering system will be selected and some suggestions will be given on how to continue in developing PDM.

Due to the wide scope of the subject, the following procedures in developing Sulzer's PDM are presented.

Keywords	Product Data Management, item, item numbering

Table of Contents

Lyhenteet

PDM	Product Data Management
PLM	Product Lifecycle Management
ERP	Enterprise Resource Planning
PLC	Product Life Cycle

1 Introduction

1.1 Background

PDM is an important part of modern business. With it companies are able to keep their data in good order which makes them more efficient. Unfortunately many companies have been neglecting PDM system's maintenance which can lead into serious disorder. One of these things is the item numbering.

Sulzer has grown through takeovers and mergers. Due to this a concern has risen about parallel item numbering systems. This Bachelor's thesis goes through different kinds of item numbering systems which are used at Sulzer Pumps. In addition the thesis focuses on finding the best item numbering system.

Sulzer

Sulzer has been a developer of centrifugal pumps since year 1857 and is one of the world's oldest pump manufacturers that still exists. Sulzer is a well-known company worldwide. It specializes in pumping and mixing technology and is the leading provider in its key markets of oil and gas, power and water. [4.]

Sulzer has a long a history which includes different kinds of products along the way. The company started as a simple iron foundry in Winterthur Switzerland. It grew rapidly with the help of design engineer Charles Brown who developed groundbreaking new steam engines which were of decisive importance for the advancement of the company. Steam engines were the driving force until late 19th century when diesel engines were developed and on which Sulzer was able to obtain the license in Switzerland. [4.]

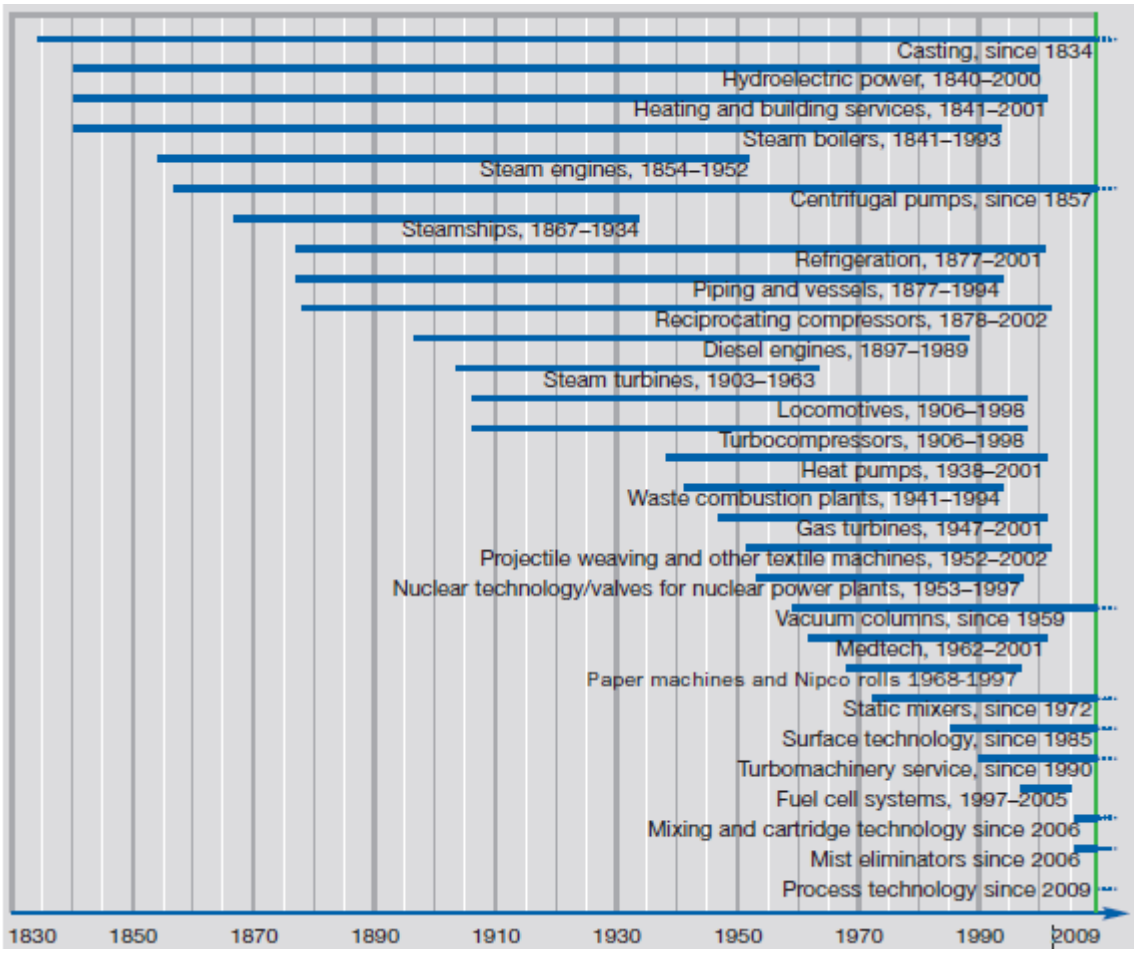


Figure 1 Key activities of Sulzer since 1834. [4.]

Sulzer had a broad range of products until the end of the 20th century. Then it streamlined its activities which lead into termination of some business fields. Sulzer consists currently of four divisions which are Sulzer Pumps, Sulzer Metco, Sulzer Chemtech and Sulzer Turbo Services. [4.]

1.2 Objectives

The objective of this Bachelor's thesis is to study what kinds of item numbering systems are used in Sulzer Pumps. From these the best one will be decided after inspecting their benefits and disadvantages.

1.3 Perspective and Boundaries

This Bachelor's thesis is written from the product structure designers' point of view. They are the ones who maintain the item data at Sulzer Pumps Finland Oy.

The theory starts with general information of PDM and PDM systems. Eventually it starts to concentrate more on item management. The theory disregards the type hierarchies since they are not used in Sulzer Pumps' PDM. The focus will be heavily on what kinds of item numbering systems are used and how they work.

This Bachelor's thesis studies the situation of Sulzer's current PDM and reveals the vulnerabilities in it. The thesis describes the key factors in the problematic situations, but more studies are required in the future since the material is so wide.

1.4 Structure

Chapter 1 introduces the company, objectives, perspective and boundaries of the thesis. Chapter 2 gives general information and theories about PDM and PDM systems. Chapter 3 describes the theory of item management.

Chapter 4 introduces three different item numbering systems and reveals some of their benefits and disadvantages. Chapter 5 will introduce Sulzer Pump's item numbering systems. Chapters 4 and 5 are the most important chapters from Sulzer Pump's point of view. Chapter 6 will draw the conclusions.

2 PDM

There are sometimes misconceptions between PDM and a PDM system. In fact PDM is a systematic way of planning, controlling, managing and monitoring information that is used through the entire PLC. A PDM system is an implementation for managing product information and the implemented processes. [3, s. 20; 2, s.18.]

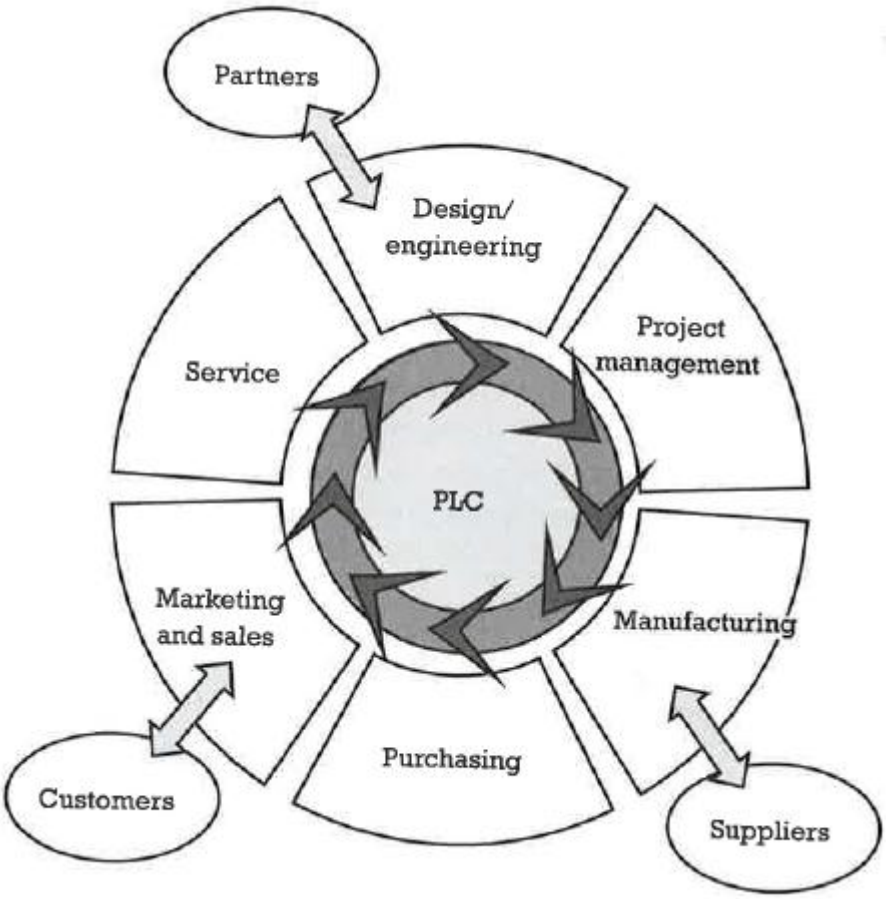


Figure 2 PDM supporting whole PLC. [3, s.20.]

In figure 2 the processes which are affected by PDM are shown. Mainly the data for the PDM system is created in the design phase. In addition, other people (e.g., partners, suppliers, and customers) with different roles also have an effect in it during PLC. Figure 2 shows how the different processes are gathered around the PLC. [3, s. 20.]

3 Item Management

3.1 Item Groups

Item Management is one of the most important processes in companies. It is crucial to achieve a working PDM system. From the PDM point of view an item can be anything that has its own identity, some kind of service or material for example. In table 1 there are typically used item groups but usually companies have to decide themselves which ones are necessary for their company. [1, s. 15-16.]

Table 1. Common Item Groups with examples [Modified 1, s. 15]

Physical Items • Systems, assemblies, parts, components etc. • Materials • Bought components • Casts and forged pieces	**Operations** • Special deliveries • Projects • Work
Services • Bought services • Sold services	**Stakeholders** • Customers • Supplier

It is not always obvious which things should be presented as items. For example when describing bolts, if you have a single bolt, should it be presented as a different item from a box of bolts? If that is the case these two items should be linked together in some way. [1, s. 15-16.]

When a standard component is bought from outside the company it often has different manufacturers. If these components are interchangeable they go under the same item

which is independent from the manufacturer. This item will therefore be used in part lists for example. In addition every component from different manufacturers also needs their own item. [1, s. 16.]

3.2 Item codes and Descriptions

Every Item must have a unique item number. Usually an item has quite a short and predefined number and an informal description. In a global environment the description must be in several different languages. In addition to the number, an item may also have separately shorter and longer descriptions. [1, s. 16-17.]

The description must have a coherent way of using words which should be agreed upon inside the company or taken from a suitable standard. For translating multilingual descriptions a vocabulary must be made. [1, s. 17.]

There are three kinds of item numbering systems: intelligent, semi-intelligent and random. These will be explained in depth in chapter 4.

3.3 Local and Global Item Codes

Large companies buy smaller companies which leads to duplicate item numbers for the same items. In this case items must be integrated in order to have only one company-wide item number for each item which is used inside the company. [1, s. 17-18.]

Integrated item numbers bring several benefits. It helps keeping track on the item usage and enables focusing purchases for the same items in one place. Without integrated item numbers, a company may buy components in small amounts for higher prices or buy them for different prices or maybe even compete against itself. Integrated item numbers also help departments to communicate and are important if production is transferred into other departments. [1, s. 18.]

Even when integrated item numbers have been made, local item numbers must be preserved as long as documentation that refers to them is still in use. There are several ways to perform this. One option is to use company-wide item numbers when documenting new products and add a code in front of every item number which tells which

department's item number it is. In addition every department has its own conversion chart about the correspondence of company-wide and local item numbers. [1, s. 18.]

3.4 Metadata

Every item has a group of predefined information. There are several phrases used when talking about these. The most commonly used ones are such as "attribute", "parameter" and "metadata". In this Bachelor's thesis the phrase "metadata" will be used. [1, s. 20]

Every metadata has a simple code with a lot of restrictions. The code itself consists of letters and numbers. In addition the metadata has an informal short description which will give more information about the metadata. If more information is required the metadata has a longer description, too. Lastly the metadata has a value type which dictates what kinds of values can be given to the metadata. [1, s. 25-26.]

Metadata has often integers, strings and dates as value types. In PDM systems a list of options can be created which consists of values that can be given to the metadata. This will able the user to give different metadata values to the item. [1, s. 26.]

Without the list users could input any kinds of values for the metadata which would lead into problems. It would make it really hard to search and categorize with metadata values since people might input differently each time. For example a designer name could be written like "Matti Virtanen", "M Virtanen", "Matti V." or there might even be typographical errors like "Mti Virtanen", "Matti Vitanen". [1, s. 26.]

Sometimes items will need several values. For example if the item can be produced in several different places then several values for it would be needed. [1, s. 26.]

3.5 Item Classification

Item classification is required when it is important to find certain items with different metadata. There are people with different backgrounds who use the PDM systems. For example a designer may search with different metadata than a salesman or purchaser. Couple of examples on how items could be classified:

- Random grouping. As the name states it has random items in it but usually they have something that binds them together. These items under this grouping could be “to be updated” items for example. There is usually nothing else in common other than that someone has said that these items belong into the same group.

- Metadata grouping. Consists of items which have certain metadata values. Items in this group will keep varying since both item and grouping requirement values can be changed.

- Classification. Items can be grouped in predefined hierarchical classes. It is possible that the same group of items is classified in several different ways. The classification improves the usability of items and prevents duplicate items by making it easier to find a desired item. In some fields there are already standardized item classification systems. [1, s. 27-28]

3.6 Item Versions

Every PDM system has versions in some form. There are two kinds of phenomena available to versions. These are revisions which are based on time and variants which are optional versions of the same item. [1, s. 32.]

3.6.1 Revisions

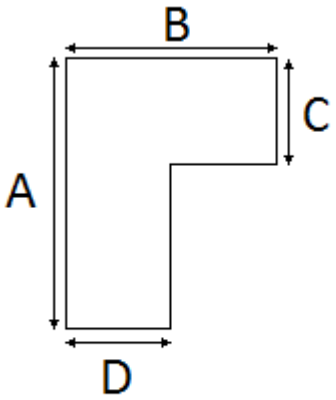
Revisions are born when a new version of an item is made that replaces the old version. Therefore, it must have a similar shape, function and compatibility. This principle is called “FFF” (form, fit, and function). [1, s. 32-33.]

Revision codes are usually strings of numbers and/or letters. Usually revision codes have a multidimensional meaning e.g. their code consists of two parts. One part indicates major changes and second part indicates minor changes. For example: 1.0 where 1 changes when major changes are made and 0 when minor. Every time major change happens the minor number will go down to 0. [1, s. 33.]

A policy must be made when a new revision should be made. Some minor changes will not require new revisions. The policy must include clear rules what are “minor” and “major” changes. [1, s. 34.]

3.6.2 Variants

There are often items that are similar but their metadata values vary (example in figure 3). These are called variants. Variations of the items can be multidimensional meaning that they can vary in many different ways at the same time. [1, s. 36]



Variant	A	B	C	D
1	90	80	25	30
…	…	…	…	…

Figure 3 Multiple Variants in Same Picture [modified 1. s. 36]

Usually a variant code is put as a suffix to item code. The suffix is coded with some logic based on the changing metadata. Sometimes variants have the same item number but the same item will vary based on changing metadata. [1, s. 36-37]

3.6.3 Revisions and Variants

An item may have simultaneously both revisions and variants. If the variants and revisions are in the same picture, as in figure 3, it is easy to arrange them as shown in figure 4. This means that every revision has its own variants. Sometimes it is better to use this other way around meaning that variants will have their own revisions. [1, s. 37]

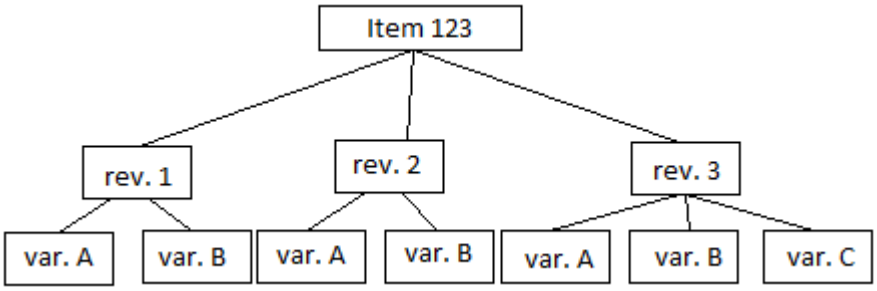


Figure 4 Item-Revision-Variant-Hierarchy [modified 1, s. 38]

4 Item Numbering Systems

Item numbering systems are an important part of PDM. They are assigned by companies for each of their documents and parts. The logic between numbering varies from really intelligent system to a completely random system. In this chapter we go through what kinds of systems exist.

4.1 Intelligent

In an intelligent item numbering systems each character in the item number refers to some metadata of the document or part. The number generation for the item number varies depending on the system. Most systems allow manual inputs but mostly it is automatically generated from the previously given information.

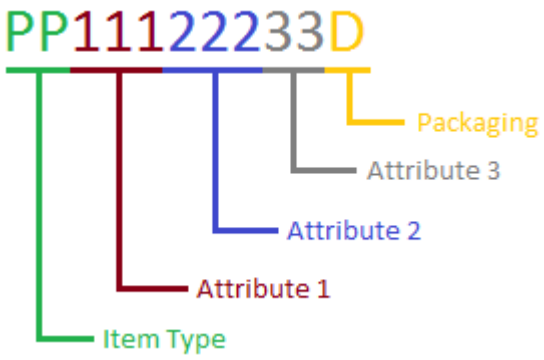


Figure 5 Intelligent Item Numbering

4.1.1 Benefits

The most significant argument for the intelligent item numbering is the easiness to recognize all significant metadata of the item just by looking at the item number. This will make it quicker and easier for the users to search items in a database and make them able to recognize items without checking the database. It also prevents duplicate items.

Another significant benefit is that it enables grouping, sorting and biasing based on the structure of the item number schema. The structure of the intelligent item numbering removes a lot of ambiguity which can be in the description field and may even rend whole the description field useless. This prevents the user from inputting data that may have errors and/or ambiguity in it.

There are also some other minor benefits from the reduction of required data entry. For example: less storage needed since based on reduction of descriptive entries, simplified system interfaces. [6.]

4.1.2 Disadvantages

There are a lot of arguments against intelligent item numbering. Some of the most significant ones will be mentioned. Firstly there is the fact that it is sometimes impossible to describe every significant variable of the item. In addition some items may not share the same significant variables.

Secondly there is the requirement for documentation or to memorize how to use and identify item numbers based on the intelligent scheme.

Lastly, there is always a danger that the intelligent item numbering will fall short. Companies tend to grow through the acquisition of other companies and those will have their own item and item codes. Usually the parent company's numbering methodology will be implemented into the acquired company. This means that every item from the acquired company must be integrated into the parent company's system. This will cause high stress on the system and if all the data is added manually there is a big chance of making errors.

A final argument is the issue of error rate due to manual entry. Because most PLM systems do not capture the intelligence and the logic is required to administrate a numbering system. They usually allow a string input field so the system can handle intelligent item numbers. As a result, a user at some point will enter an item number incorrectly where it will go unchecked and get released. When a user inputs 15 or more characters manually the chance for error is almost 100 % according to several studies. This is a significant downside while using intelligent item numbers. [6.]

4.2 Semi-Intelligent

Semi-Intelligent item numbering means that the numbering consists of some predefined or manually added characters with intelligence behind them. Some part of the item number will be completely random. With this there is a simple categorization while keeping characters unique through a randomly generated portion.

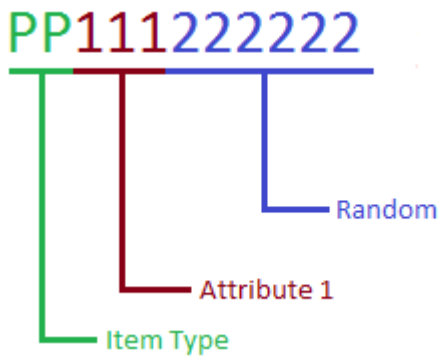


Figure 6 Semi-Intelligent Part Numbering

4.2.1 Benefits

Semi-intelligent item numbering systems allow an easy identification of classes or families of items based on a part of the number. Sometimes a prefix is added to the item number that is a cage or a commodity code. This will allow search defining easily by entering the intelligent part of the code which will significantly reduce the search results.

When working with external systems it is easier to identify, sort and in general work with sets of numbers. It is also easier for the user to learn a set of cage codes and classifications.

Most systems today support autonumber sequences that have a static prefix and suffix making it less vulnerable to errors. [7.]

4.2.2 Disadvantages

As with every other numbering system semi-intelligent has its own flaws. Commodity codes usually represent classes or families of items. For instance class 9XX could be connecting components, 91X could be screws, 915 could be cap head types.

Due to the rapid development of new types of items, commodity codes can quickly fall short based on the predefined length of characters. In addition if/when a company starts using a new product line, which requires a completely new classification, implementing this may cause problems into the existing system or may even prove to be impossible in certain situations. There might even rise a problem where an item falls into multiple categories due to ambiguous categorizations. There are a lot of other scenarios which might violate the original intent of the semi-intelligent schema.

It also has similar problems as the intelligent numbering. For example when a company is acquired and its commodity codes will not match up, this will make the system ineffective from the intelligence standpoint. The intelligent nature of these types of numbers will suffer from human errors in categorization.

Lastly there might be an issue with data reuse. Due to part of the item number being random it is easy create duplicate items without adding new attributes to help with categorization and recognition and to assure uniqueness of the system. [7.]

4.3 Random

Random item numbering ensures uniqueness for the item so there is no need for design. Even though it is called a random number, usually systems derive these sequen-

tially from a “next number” entry in the database. In relation to FFF principle the number has no significance.

Figure 7 Random Part Numbering

4.3.1 Benefits

The most notable benefit from random item numbering is its ability to assure item number’s uniqueness. Since the number has no significance in random numbering, this makes data migrations due to combining systems, upgrading and moving to the new systems or company acquisitions easier and less costly. It also requires less data cleansing and correcting and greatly reduces the possibility of duplicate part numbers.

Random numbers do not require user training on how to configure or select the number and this will greatly reduce costs and eliminate errors made by the user. Random numbers are infinitely expandable and therefore require no future planning for growth. [7.]

4.3.2 Disadvantages

The most notable disadvantage of random item numbering is its inability to understand what the item is from the number alone. It also requires not only a system setup but it also requires the users to configure these and set/input values in order to make it as intelligible and functional as the previous numbering systems.

It also has to be noted that a random item number is useful only when the associated metadata is available. If the system malfunctions it is impossible to recognize the items from the number alone.

Since random item numbers are heavily dependent on the descriptions it gives a chance for users to make errors while making inputs. [7.]

5 Standard Part Item Management at Sulzer Pumps

There are currently three different item numbering systems used at Sulzer Pumps. The first one is an intelligent item numbering system. The second one is intelligent with a classification. The last one is the semi-intelligent system without a classification. In this chapter the item numbering system for each sector will be explained.

5.1 Intelligent

Intelligent item numbering system at Sulzer Pumps for standard items is formed from two parts. The first character is a letter which represents the main class of the item. Next seven characters are decided based on item attributes. After those comes a material code which is two characters long.

Example: Hexagonal steel screw (ISO yyyy) M10x100

Step 1: Main component class will be chosen. In this case it is “Connecting components” so letter A is the first character.

Main component classes

A	Connecting components
B	Components
C	Piping equipment
D	Assemblied units
E	Sealing equipment
F	Mechanical seals

Figure 8 Main component classes

Step 2: Screw type will be chosen. In this case it is Hexagonal screw done according to ISO yyyy. Next characters will be 12.

11 = Hexagonal screw ISO xxxx

12 = Hexagonal screw ISO yyyy

13 = Hexagonal screw, in-thread

Figure 9 Screw type

Step 3: Thread and size will be chosen. In this case M10. Next characters will be 102.

102	=	M2
103	=	M3
104	=	M4
105	=	M5
106	=	M6
108	=	M8
110	=	M10
112	=	M12

Figure 10 Thread and size

Step 4: Length will be chosen. In this case 100 mm. Next characters will be A0.

50	=	50 mm
90	=	90 mm
A0	=	100 mm
A5	=	105 mm
B0	=	110 mm
B5	=	115 mm
C0	=	120 mm

Figure 11 Length

Step 5: Material will be chosen. In this case steel. Last character will be 01.

01 = Steel

02 = Aluminium

03 = Stainless steel

Finally code key is completed: A12102A001.

5.2 Intelligent with Classification

The intelligent item numbering system with classification at Sulzer Pumps for standard items is formed from three parts. Firstly, there is a specific base number assigned to a certain type. Then there are numbers added to identify the size and lastly numbers identifying the material of construction. The classification principle can be seen in figure [12]

Fasteners				
Section Title				
⊞ **Fasteners**		Print		
⊟ **Nuts**		Print		
⊞ Inch	Inch	Print		
⊟ Metric	Metric	Print		
⊞ Bearing Nuts	Metric	Print		
⊞ Capnuts	Metric	Print		
⊞ Hex Nuts	Metric	Print		
⊞ Others	Metric	Print		
⊞ Superbolt Nuts	Metric	Print		
⊟ **Small Parts**		Print		
⊞ Inch	Inch	Print		
⊞ Metric	Metric	Print		

Figure 12 Classification

Example: Allocating steel hex nut M10 an item number (Masszahl is size and Werkstoffkennzahl is material of construction).

Gewinde d_1	Stamm-Nr.015.201 Maß-zahl	Werkstoff-Kennzahl											d_2 min	d_3 max	m max	s max	e min	Masse
		00	10	20	40	50	70	75	76	77	78	79	80	mm				kg
M 4	010.9	x			x									5,9	4,6	3,2	7,0	7,66	0,001
M 5	011.1	x			x									6,9	5,75	4,7	8,0	8,79	0,001
M 6	011.3	x			x									8,9	6,75	5,2	10,0	11,05	0,002
M 8	011.5	x			x									11,6	8,75	6,8	13,0	14,38	0,005
M10	011.7	x			x	x	x	x						14,6	10,8	8,4	17,0[3]	18,90	0,012
M12	011.9	x			x	x	x	x			x			16,6	13,0	10,8	19,0[3]	21,10	0,017
M16	012.2	x			x		x	x						22,5	17,3	14,8	24,0	26,75	0,033
M20	012.5	x		x	x		x	x					x	27,7	21,6	18,0	30,0	32,95	0,064
M24	012.7	x			x		x	x						33,3	25,9	21,5	36,0	39,55	0,110
M27 [4]	013.0				x		x							38,0	29,1	23,8	41,0	45,20	0,167
M30	013.2	x		x	x		x	x						42,8	32,4	25,6	46,0	50,85	0,223
M36	013.6	x			x									51,1	38,9	31,0	55,0	60,79	0,393
M42	014.0				x									60,0	45,4	34,0	65,0	71,30	0,652
M48	014.2				x									69,5	51,8	38,0	75,0	82,60	0,977
M56	014.6													78,7	60,5	45,0	85,0	93,56	1,420
M64	015.0													88,2	69,1	51,0	95,0	104,86	1,690

Figure 13 Hex nut's attributes

Step 1: There is a specific base number assigned to this type. So 015.201.01 number will be chosen.

Step 2: Attributes of the hex nuts have to be read from its' drawing. In this case size is 011.7

Step 3: Material of the hex nut is chosen. In this case steel which is number 00.

Finally code key is completed: 015201011700

5.3 Semi-Intelligent without Classification

The semi-intelligent item numbering system without classification at Sulzer Pumps for standard items is formed from three parts. The first character presents the item type. The second character is a position number. The last character is a running number. Some of the random numbers are reserved for specific locations.

Part Number	Description
6 000 XXXX	Special Stators, assemblies and temporary numbers
0 001 XXXX	Standard Parts
6 002 XXXX	Upper Lid Assemblies
2 / 3 100 XXXX	Motor Housing
3 101 XXXX	Cut Bars for Rotor Shafts Cooling Jackets
4 101 XXXX	Outer Jacket
2 / 3 102 XXXX	Upper Lid
4 102 XXXX	Upper Lid

Figure 14 Examples of item numbering

ITEM 1st 4 digits	NUMBERS Last 4 digits	GROUP CLASSIFICATION
0001	5000 - 5999	Standard Parts Groupings - Phantoms.
0100 to 0999	0000 - 9999	Final Assemblies, Pumps & Motors. **Important:** Blocks of numbers to be allocated by agreement with ABS Scheiderhoehe
1280 1342 1597 1599 1600	5000 - 5999 5000 - 5999 5000 - 5999 5000 - 5999 5000 - 5999	Float Switch Assemblies. Nameplates (Adhesive) & Labels Instruction Booklets & Leaflets. Cartons, Crates & Packaging Fittings. Product Brochures

Figure 15 Example of reserved item numbers

6 Summary and Conclusion

At present the amount of literature related to PDM or item numbering is rather scarce. Nonetheless it is a popular topic in blogs and therefore some blogs are used as a source in this Bachelor's thesis. There does not seem to be any exact information on what would be the best system.

Every item numbering system has their benefits and disadvantages. The ones described in this Bachelor's thesis are the most popular ones but there are many more to be found. The bottom line is that the numbering systems are to be designed based on the company's needs. That is why it varies. What is good for one company may not be good for the others.

In general a random item numbering system with wide metadata would most likely be the best in this case since it is not as vulnerable as intelligent and semi-intelligent systems. It is cheaper and easier to implement in companies that have been merged. In addition the fact that it ensures the uniqueness of the code is very important when thinking about the future development of a company.

Further investigations should be done before making any decisions in this matter. Wider survey inside the company should be made since there might exist even more parallel item numbering systems in Sulzer Pumps.

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